REMARKS/ARGUMENTS

Claims 1-25 are pending in the application. Claims 1, 7, 13-14, 19, and 21-22 are amended herein. The Applicant hereby requests further examination and reconsideration of the application in view of the foregoing amendments and these remarks.

Specification

In paragraph 1 of the office action, the Examiner objected to the disclosure for certain informalities. In response, the Applicant has amended the specification as requested by the Examiner.

Double Patenting

In paragraph 2, the Examiner provisionally rejected claims 1, 10-11, 18-19, and 24 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 8-9, and 11 of co-pending Application No. 10/017,174. In response, the Applicant submits that claims 1, 10-11, 18-19, and 24 are patentably distinct from claims 1, 8-9, and 11 in the co-pending application.

In particular, according to currently amended claim 1, at least one input port can be programmably reconfigured to store data in different numbers of input routing queues that are associated with a single output port, and at least one output port can be programmably reconfigured to receive data from different numbers output routing queues that are associated with a single input port. The Applicant submits that these features patentably distinguish the invention of claim 1 over claims 1, 8-9, and 11 in the co-pending application, which do not recite such features.

According to claim 11, the output stage is configured to transmit status information about the output stage to the input stage, and the input stage is configured to generate bids transmitted to the switching fabric based on the status information about the output stage. The Applicant submits that these features patentably distinguish the invention of claim 11 over claims 1, 8-9, and 11 in the co-pending application, which do not recite such features.

According to claim 19, for each rejected bid, the grant/rejection signal explicitly identifies a reason for rejecting the bid, wherein the identified reason is one of a plurality of different possible reasons for rejecting the bid, and the input stage determines how to react to a rejected bid based on the reason the bid was rejected, wherein the input stage is adapted to react differently for different possible reasons for rejecting the bid. The Applicant submits that these features patentably distinguish the invention of claim 19 over claims 1, 8-9, and 11 in the co-pending application, which do not recite such features.

In view of the foregoing, the Applicant submits that the provisional rejections of claims 1, 10-11, 18-19, and 24 under the judicially created doctrine of obviousness-type double patenting have been overcome.

Claim Rejections - 35 USC 112

In paragraph 5, the Examiner rejected claims 15 and 20 under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. In particular, the Examiner stated that the port expansion function of the input devices in the input stage and the port contraction function of the output devices in the output stage are "not adequately disclosed in the specification and consequently

raises doubts to one of ordinary skill in the art of Applicant's possession of invention at the time of filing."

As described in the paragraph beginning on page 6, line 32, each input device in the input stage of a three-stage switch fabric configuration performs a user port expansion function to connect an associated set of one or more ingress line cards (also referred to as ingress traffic management (TM) ports) to all crossbar devices in the switching stage. In addition, each output device in the output stage of the configuration performs a user port contraction function to concentrate traffic from all crossbar devices and forward the traffic to an associated set of one or more egress line cards (i.e., egress TM ports).

In light of these explicit teachings in the specification, the Applicant submits that the written description requirement is satisfied and that therefore the rejections of claims 15 and 20 based on Section 112, first paragraph, have been overcome.

Claim Rejections - 35 USC 102

In paragraph 7, the Examiner rejected claims 1-10 under 35 U.S.C. 102(e) as being anticipated by Turner. In response, the Applicant submits that currently amended claim 1 and therefore claims 2-10, which depend variously from claim 1, are allowable over Turner.

Claim 1 has been amended to clarify that (1) at least one input port can be programmably reconfigured to store data in different numbers of input routing queues that are associated with a single output port and (2) at least one output port can be programmably reconfigured to receive data from different numbers of output routing queues that are associated with a single input port.

Turner teaches, in Fig. 8, a multi-stage interconnection network in which a single input port can store data in three input routing queues, and a single output port can receive data from three output routing queues. Significantly, however, there is no teaching or even suggestion in Turner that that multi-stage interconnection network can be programmably reconfigured to change the number of input routing queues that are associated with that single input port or change the number of output routing queues that are associated with the single input port.

The ability of the invention of claim 1 to programmably reconfigure input and output ports enables a single switch fabric to support a wide variety of non-blocking operating configurations. For example, described on page 14, line 20, to page 16, line 33, an exemplary (32x16x32) switch fabric having 32 input devices, 16 crossbar device, and 32 output devices can be programmable configured such that each input device has all 32 of its input ports configured to ingress line cards and each output device has all 32 of its output ports configured to egress line cards, where there are a total of 1024 configured output ports in the output stage (i.e., 32 output devices, each with 32 output ports configured to egress line cards). In that case, in order to provide a non-blocking switch fabric, each of the 1024 input routing queues in each input device could be logically associated with a different one of the 1024 output ports. In order to be able to reach any of the 1024 output ports, each of the input ports in each input device would be able to store user data to any of the 1024 input routing queues of that input device.

Alternatively, that same (32x16x32) switch fabric could programmable configured such that each input device had only 16 of its input ports configured to ingress line cards and each output device had only 16 of its output ports configured to egress line cards, such that there would be a total of 512 configured output ports in the output stage (i.e., 32 output devices, each with only 16 output ports configured to egress line cards). In that case, a different pair of the 1024 input routing queues in each

input device could be logically associated with a different one of the 512 configured output ports, while still providing a non-blocking switch fabric. Since there could now be two different input routing queues for each configured output port, the logical associations between the 16 configured input ports and the 512 pairs of input routing queues of each input device can be programmed when the switch fabric is configured. For example, in a particular input device, for a particular pair of input routing queues (e.g., "Queue A" and "Queue B") associated with a particular one of the 512 configured output ports (e.g., "Output Port I"), a first subset of the 16 configured input ports could be programmed to store all of their user data destined for Output Port I into Queue A, while a second subset of the 16 configured input ports could be programmed to store all of their user data destined for Output Port I into Queue B. Alternatively, the 16 configured input ports could be programmed to store one set of user data destined for Output Port I into Queue A and to store another set of user data destined for Output Port I into Queue B, thereby doubling the number of user traffic classes.

In general, each time the switch fabric is reconfigured, each input port in each input device can be programmed to be logically associated with one or more routing queues in that input device, where the one or more routing queues are selected from a group of routing queues whose number is dictated by the number of input ports of that input device that are configured to ingress line cards and the total number of configured output ports in the output stage of the switch fabric.

Similarly, each time the switch fabric is reconfigured, each output port in each output device can be programmed to be logically associated with one or more routing queues in that output device, where the one or more routing queues are selected from a group of routing queues whose number is dictated by the number of output ports of that output device that are configured to egress line cards and the total number of configured input ports in the input stage of the switch fabric. The programmability of the logical association between output ports and routing queues in output devices is analogous to that for the input devices.

For a given configuration, the mapping between routing queues in the input devices and routing queues in the output devices is determined based on the logical associations (a) between the input ports and the routing queues in the input devices and (b) between the output ports and the routing queues in the output devices.

The networks taught in Turner do not provide such advantageous operational flexibility.

For all these reasons, the Applicant submits that claim 1 is allowable over Turner. Since claims 2-10 depend variously from claim 1, it is further submitted that those claims are also allowable over Turner. The Applicant submits therefore that the rejections of claims 1-10 under Section 102(e) have been overcome.

Claim Rejections - 35 USC 103

In paragraph 9, the Examiner rejected claims 11-25 under 35 U.S.C. 103(a) as being unpatentable over Turner in view of Angle. In response, the Applicant submits that currently amended claims 11 and 19 and therefore claims 12-18 and 20-25, which depend variously from claims 11 and 19, are allowable over the cited references.

Claim 11

According to claim 11, the input stage transmits bids to the switching stage to request connections through the switching stage for routing the data, the output stage is configured to transmit

status information about the output stage to the input stage, and the input stage is configured to generate the bids transmitted to the switching fabric based on the status information about the output stage. The cited references do not teach or even suggest such a combination of features.

Angle teaches, in Fig. 1, a three-stage switch fabric (i.e., network device 100) in which fabric configuration manager 110 may be considered to be part of the middle, switching stage along with fabric 120. As accurately characterized by the Examiner, Angle discloses an input stage (i.e., line cards 105) that transmits bids to the switching stage (i.e., fabric configuration manager 110) to request connections through the switching stage for routing data. Fabric configuration manager 110 also receives "control information from output ports [i.e., in an output stage] regarding traffic." Fabric configuration manager determines whether to accept or reject the bids from the input stage based on that control information from the output stage.

Significantly, however, this is not what is recited in claim 11. Claim 11 does not recite that the output stage is configured to transmit status information about the output stage to the switching stage, where the switching stage is configured to determine whether to accept or reject the bids based on the status information about the output stage. (Note that these features are recited in claim 12.) Rather, claim 11 recites that the output stage is configured to transmit status information about the output stage to the input stage, where the input stage is configured to generate the bids transmitted to the switching fabric based on the status information about the output stage.

Fig. 28 illustrates the difference between the features recited in claim 11 from those recited in claim 12 for a particular embodiment of the invention. As shown in Fig. 28, per port back-pressure (BP) status information is transmitted from the third stage (i.e., the output stage in the claims) to the second stage (i.e., the switching stage in the claims), while per queue BP status information is transmitted from the third stage to the first stage (i.e., the input stage in the claims).

As described in the specification on page 31, lines 25-31, if the per queue BP status information indicates that a particular queue is currently full, then the input stage knows that it should not transmit any bids to the switching stage for that particular queue. In that way, the input stage generates bids based on the status information about the output stage. Angle does not teach or even suggest such features. In particular, Angle does not teach or even suggest that the generation of bids depends on status information about the output stage.

The invention of claim 11 advantageously reduces the volume of bids transmitted from the input stage to the switching stage and thereby reduces the processing load on the switching stage for handling bids received from the input stage.

For all these reasons, the Applicant submits that claim 11 is allowable over the cited references. Since claims 12-18 depend variously from claim 11, it is further submitted that those claims are also allowable over the cited references.

Claim 12

As mentioned in the previous section, claim 12 recites that the output stage is further configured to transmit status information about the output stage to the switching stage, and the switching stage is configured to determine whether to accept or reject the bids based on the status information about the output stage. As such, claim 12 is directed to a switch fabric that involves the transmission of status information from the output stage to both the input stage (as recited in claim 11) and the switching stage (as recited in claim 12). The cited references teach switch fabrics that have only one type of

transmission of status information (e.g., from the output stage only to the switching stage as taught in Fig. 1 of Angle), not both types (i.e., from the output stage to the switching stage and from the output stage to the input stage). The Applicant submits that this provides additional reasons for the allowability of claim 12 (and therefore claim 13) over the cited references.

Claim 13

According to claim 13, the status information about the output stage that is used by the input stage corresponds to per queue status information for each output routing queue, and the status information about the output stage that is used by the switching stage corresponds to per port status information for each output port. Claim 13 has been amended to clarify that the per port status information is different from the per queue status information for an output port associated with more than one output routing queue.

As described earlier, Angle teaches the transmission of only one type of status information (i.e., per port status information) from the output stage to the switching stage. Angle does not teach the transmission of a second, different type of status information (i.e., per queue status information) from the output stage to the input stage. Note that, for an output port that is associated with two or more output routing queues, the per queue status information could indicate that a particular output routing queue is full, while the corresponding per port status information could indicate that the corresponding output port is not full, if one or more of the other output routing queues associated with that output port are not full. Thus, in general, per queue status information is different from per port status information.

The Applicant submits that this provides additional reasons for the allowability of claim 13 over the cited references.

Claim 14

According to claim 14, the status information about the output stage that is used by the input stage corresponds to (1) per queue status information for each output routing queue and (2) per port status information for each output port. Like claim 13, claim 14 has been amended to clarify that the per port status information is different from the per queue status information for an output port associated more than one output routing queue.

As described in the previous section, Angle teaches the transmission of only one type of status information (i.e., per port status information). Angle does not teach the transmission of a second, different type of status information (i.e., per queue status information).

The Applicant submits that this provides additional reasons for the allowability of claim 14 over the cited references.

Claim 16

According to claim 16, the status information transmitted from each output device to all of the input devices comprises both per queue status information for each output routing queue of that output device and per port status information for each output port of that output device. Like claims 13 and 14, claim 16 has been amended to clarify that the per port status information is different from the per queue status information for an output port associated more than one output routing queue. As with claims 13 and 14, the Applicant submits that this provides additional reasons for the allowability of claim 16 (and therefore claim 17) over the cited references.

Claim 19

According to claim 19, the input stage is configured to transmit bids to the switching stage to request connections through the switching stage for routing the data to the output stage; the switching stage is configured to determine whether to accept or reject each bid and to transmit a grant/rejection signal to the input stage identifying whether the bid is accepted or rejected; for each rejected bid, the grant/rejection signal explicitly identifies a reason for rejecting the bid; and the input stage determines how to react to a rejected bid based on the reason the bid was rejected. Claim 19 has been amended to clarify that the identified reason is one of a plurality of different possible reasons for rejecting the bid, and the input stage is adapted to react differently for different possible reasons for rejecting the bid. The cited references do not teach or even suggest such a combination features.

Figs. 20-21 show an example of the invention of claim 19. According to Fig. 20, in this exemplary implementation, each grant/rejection signal transmitted from the switching stage to the input stage includes a 2-bit GRANT field having one value (i.e., (00)) indicating that the bid was granted and three different values (i.e., (01), (10), and (11)) indicating that the bid was rejected, where the three different values correspond to three different reasons why the bid was rejected. See page 22, lines 10-17.

According to Fig. 21, if the reason why the bid was rejected was due to collision, then input stage will send another bid for the same output device. Otherwise, the input stage will transmit a bid for a different output device. See page 23, lines 23-32. Thus, the input stage reacts differently for different reasons for rejecting a bid.

In the three-stage switch fabric taught in Angle, the input stage transmits bids to the switching stage (i.e., fabric configuration manager 110) to request connections through the switching stage for routing the data to the output stage, where fabric configuration manager determines whether to accept or reject each bid and transmit a grant/rejection signal to the input stage identifying whether the bid is accepted or rejected. Significantly, however, in Angle, for each rejected bid, the grant/rejection signal does not explicitly identify a reason for rejecting the bid, where the identified reason is one of a plurality of different possible reasons for rejecting the bid. Furthermore, in Angle, the input stage does not determine how to react to a rejected bid based on the reason the bid was rejected, where the input stage reacts differently for different possible reasons for rejecting the bid.

For all these reasons, the Applicant submits that claim 19 is allowable over the cited references. Since claims 20-25 depend variously from claim 19, it is further submitted that those claims are also allowable over the cited references.

Claim 21

According to currently amended claim 21, if an input device determines that an initial bid is rejected due to bid collision, then the input device transmits a subsequent bid for the same output device. If, however, an input device determines that an initial bid is rejected due to back-pressure, then the input device transmits a subsequent bid for a different output device. Claim 21 has been amended to clarify that each input device explicitly determines whether initial bids are rejected due to bid collisions or due to back-pressure. Since the cited references do not teach such a combination of features, the Applicant submits that this provides additional reasons for the allowability of claim 21 (and therefore claim 22) over the cited references.

Claim 22

According to claim 22, the back-pressure comprises both per queue status information for each output routing queue in each output device and per port status information for each output port in each output device. Like claims 13-14 and 16, claim 22 has been amended to clarify that the per port status information is different from the per queue status information for an output port associated more than one output routing queue. As with claims 13-14 and 16, the Applicant submits that this provides additional reasons for the allowability of claim 22 over the cited references.

In view of the foregoing, the Applicant submits that the rejections of claims 11-25 under Section 103(a) have been overcome.

In view of the above amendments and remarks, the Applicant believes that the now-pending claims are in condition for allowance. Therefore, the Applicant believes that the entire application is now in condition for allowance, and early and favorable action is respectfully solicited.

Respectfully submitted,

Date: 12/7/05

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